

REMARKS

Applicant acknowledges with appreciation the indicated allowability, subject to being rewritten in independent form, of claims 66, 88, 92, 96 and 100 and the withdrawal of the restriction requirement. The allowable claims have now been rewritten in independent form. Claims 72 and 81 have been cancelled without prejudice.

In addition, the specification and claims 52, 59, 69 and 76 have been amended to clarify that the Blaine measurement is a ratio of the surface area in square centimeters to the weight in grams of the particles as stated at page 5, lines 18-20, of the specification. The references to "fineness" have been deleted and the units have been added to the claims.

Claims 52-71, 73-80, and 82-104 are pending.

THE OFFICE ACTION

It is respectfully noted that the Examiner has rejected the different classes of claims in separate Sections 6 to 13 of the Office Action which span pages 3 to 16. As presently understood all of the claims (with the exception of those indicated allowable and claims 52-58 and 69-75) have been found to be unpatentable under 35 U.S.C. §103(a) over the same references, namely, over Hettinger, Jr. in view of Senes, Leftin, Schriesheim and Mason. Claims 52-58 and 69-75 are also rejected over these references with the exception that Mason is not cited.

Sections 6 to 8 of the Office Action are directed to the claims to the catalyst composition where the catalyst precursors are identified by their elemental constituents (claims 52-58) and their method of preparation (claims 69-75).

Section 10 refers to claims 59-65, 67 and 68. These claims are directed to the catalyst compositions formed by the admixture of certain composite materials (e.g., volcanic ash and cement components) with elemental components.

Section 11 refers to claims 76-84. These claims are directed to the method of making the catalyst composition formed by the admixture of certain composite materials with elemental components.

Sections 9, 12 and 13 are directed to the methods of cracking and hydrogenating high molecular weight hydrocarbons (claims 85-87, 89-91, 93-95 and 97-99).

To simplify and avoid repetition in this response to the Office Action, each of the references shall be discussed, but once, addressing, where appropriate, the distinctions of each with respect to each of the classes of the claims.

SUMMARY OF INVENTION

As will be recalled, the subject invention relates to a liquid phase process for cracking and hydrogenating high molecular weight hydrocarbons to form lower molecular weight, transportable hydrocarbons of substantially greater value. The inventive process is dependent on the use of a novel aqueous catalyst composition which is formed upon the addition to water of a unique combination of precursors. Claimed are the catalytic composition (claims 52 to 68 and 101), the methods of making it (claims 69 to 84 and 102), and the method of cracking and hydrogenating the aforesaid heavy hydrocarbons to form low viscous lower molecular weight hydrocarbons (claims 85 to 100, 103 and 104).

As is recognized in the discussion of the prior art in the subject application and in the prior art cited by the Examiner, the cracking and hydrogenation of high molecular weight hydrocarbons conventionally takes place in the vapor phase at temperatures considerably higher than the present liquid phase process. It is most remarkable in light of the prior art that heavy non-transportable hydrocarbons, such as heavy oils, tars and asphaltenes, can be upgraded in the liquid phase at moderate conditions of temperature and pressure.

RESPONSE

Hettinger, Jr. et al.

The primary reference, Hettinger, to the extent it is relevant at all, merely shows the traditional catalytic vapor phase fluidized conversion of high boiling hydrocarbons at temperatures from about 950° F to about 1100° F (column 7, line 65, to column 8, line 14). See also Tables E-1 and E-2 in column 21, and column 23, lines 61-65. The catalyst employed is a fluidized crystalline zeolite (column 7, line 65, to column 8, line 4; column 9, lines 22-25). The novelty of the Hettinger invention is not in the conversion of the hydrocarbons, but in the periodic regeneration of the zeolite catalyst to remove residual carbon deposits (column 4, lines 20-30). This is accomplished by treating the agent catalyst with carbon dioxide (CO₂) at temperatures in the range of 1350° F up to about 1500° F in the presence of metal additives (column 4, lines 43-49; column 6, lines 34-39). These additives are not pertinent to the conversion process. It is clear that they need not even be present during the conversion of the high boiling oil feed. (See column 7, line 34-51 cited by the Examiner and the examples of Hettinger where the efficacy of the invention is only demonstrated with respect to the percentage coke removed from the carbon-contaminated catalyst.)

None of this is relevant to Applicant's catalyst or to its mode of preparation because there is absolutely no suggestion of the combinations of components in the precursors or composition of the catalyst claimed. Hettinger's complex mechanism for forming the catalyst composition also differs from Applicant's process (column 9, lines 22-33). There is no suggestion that the end results are going to be the same or even similar after undergoing the vastly different methods of preparation.

The use of Hettinger's catalyst is also significantly different. The catalyst employed in the conversion process is a solid which is fluidized in the vaporized feed. In contrast, the catalyst composition of the subject invention is in an aqueous form and can be blended with the liquid high molecular weight hydrocarbon at a temperature where no significant quantity of the feed is vaporized.

The size of the catalyst particles in Hettinger is meaningless with respect to the Blaine limitation referred to in the claims of the present invention. In the former, the size of the zeolite

particles is critical to insure they are fluidizable and optimum for converting the vaporous high boiling oil. (Column 7, lines 34-51). On the other hand, in the subject invention, the particle surface area to weight ratio of the catalyst precursors is significant in the formation of the active catalyst. Furthermore, the constituents used to form the catalytic composition of the present invention are significantly different from those used for the catalyst in Hettinger. Accordingly, one skilled in the art would not turn to the teachings of Hettinger to determine the necessary precursor particle size for making Applicant's catalyst.

With regard to the constituents of Applicants' claimed catalyst, the Examiner recognizes that the primary reference is deficient. (Section 10, second paragraph). For even greater reason, this reference cannot be said to render obvious the claims to the cracking and hydrogenating process using the claimed catalyst.

Koeppel

While not specifically cited in the rejections of the claims, in conjunction with the discussion of the Hettinger reference, the Examiner, as noted above, references the Koeppel patent. (See, for example, Section 7 of the Office Action.) The Examiner says that this reference discloses that "particles with a Blaine of 3000 have a particle size of less than 2.5 mm." But this is not so. Koeppel says that certain anhydrites, such as anhydrous calcium sulfate, including those with a Blaine ratio of 3000 cm^2/g can be used to make a cellular product having "cells of less than 2.5 mm." See Examples 1, 2, 6 and 9. The reference *does not state* that the particles having the Blaine of 3000 have any particular particle size. The "less than 2.5mm" refers to the cells of a *reaction product* of such particles. Particles of the same size can vary widely in Blaine ratios. As mentioned above, Blaine is not a measurement of particle size. Rather it is a measurement of the ratio of the surface area (in cm^2) to the particle's weight (in grams).

Senes et al.

The secondary reference, Senes, is concerned with a catalyst composition for the *dehydrogenation* of saturated compounds to form unsaturated hydrocarbons, primary olefins such as ethylene and propylene. The catalyst is contacted with a gaseous hydrocarbon feed at temperatures

between 200°C to 600°C (column 3, lines 6-22). This process is not analogous to that of the present invention. Reforming saturated hydrocarbons, such as liquefied petroleum gas and heavy fuel oils (column 2, lines 49-56) to form olefins *depletes* hydrogen from the feedstock, whereas Applicant is teaching a method which requires the *addition* of hydrogen to achieve its objective. Accordingly, one skilled in the art would not turn to this secondary reference to develop a catalyst for cracking and hydrogenation or for the cracking and *hydrogenation* process itself.

With respect to the catalyst compositions taught by Senes on column 2, lines 23-38, these are totally different from the catalyst precursors and the aqueous catalyst composition of the instant invention. The Senes composition does not require the presence of aluminum oxide or titanium dioxide and there is no mention of the presence of a transition metal salt. As to “small amounts of ferric oxide,” it is stated that such is useful to provide “good stability with respect to ethylene” (column 2, lines 3-8). The catalytic compositions of Senes “are prepared by solution diffused into the mass, which is preferably carried out by sintering at high temperature, at least equal to 1300 °C.” and “are advantageously provided in the form of pellets” (column 2, lines 35-41). In contrast, Applicant’s claimed catalyst is prepared by mixing particles having a Blaine of at least 3000 in water. Applicant’s process does not require the use of extreme temperatures to sinter the catalyst or the formation of pellets.

It is respectfully submitted, therefore, that there would be no motivation to combine the teachings of Senes, which teaches *dehydrogenation*, with the teaching of Hettinger, which teaches cracking/*hydrogenation* with regard to the catalyst discovered by Applicant, its method of preparation, or for the uses of such catalyst for upgrading high molecular hydrocarbons.

Leftin et al.

Leftin, too, is concerned with a chemical reaction which is totally different from the cracking/hydrogenation reaction with which both Applicant’s invention and the primary reference is concerned. This secondary reference teaches reactions involving ethylenically unsaturated compounds to form unsaturated esters, ethers and halides of carboxylic acids. Neither these starting materials, nor the end products sought are relevant to the instant invention. Furthermore, as in the

prior secondary references, Leftin is concerned with a vapor phase reaction (column 6, lines 46-52) which, for the reasons stated above, is of little relevance to Applicant's compositions or processes. Hence, one skilled in the art would not have been motivated to combine Leftin, which forms addition products, with Hettinger's cracking/hydrogenation process.

Schreisheim

The secondary reference, Schreisheim, is concerned with isomerization, a chemical reaction not relevant to the instant invention or properly combinable with Hettinger. Isomerization is distinctly different from the cracking/hydrogenation of Hettinger or of the instant invention. Schreisheim employs normal paraffins of 4 to 7 carbon atoms as the starting material, certainly distinguishable from the high molecular weight hydrocarbons which serve as the feedstock for Applicant's process. Such low molecular weight starting materials are the very products sought by Hettinger and the Applicant.

Furthermore, Schreisheim describes adding ferric oxide to an aluminum bromide catalyst to increase its activity (column 1, lines 57-61). Since Hettinger does not employ an aluminum bromide catalyst or perform an isomerization reaction, there would be little motivation for a skilled artisan to take note of Schreisheim's teaching. Table I of Schreisheim exemplifies the catalysts tested. None of these teach the combination of components claimed by Applicant, nor would one of ordinary skill in the art have a motivation to combine these catalysts with those in Hettinger.

Mason

Mason, as noted by the Examiner, states that Portland cement can be used as a support or carrier for the hydrogenation of high molecular weight feedstocks. (See the top of page 8 of the Office Action). But this teaching, as with certain of the other secondary references, is concerned with a reaction different from the instant invention. Whereas Applicant's process relates to *cracking* and hydrogenation, Mason has developed a process primarily to hydrogenate, in the vapor phase, medium weight olefinic type oils (API values in the range of 35 to 60) while expressly avoiding cracking (column 3, line 40-56). In other words, Mason seeks to saturate his oil without completely rupturing the carbon chains. In contrast, Applicant's process is particularly adapted to

break down the carbon chain of heavy oils having API gravities as low as 8 to 20 to produce substantially shorter chain length products. (See page 8, lines 11-20 of the subject application.)

While Mason teaches Portland cement as one of many carriers which may be used in making the catalyst, he uses the catalyst to catalyze a different reaction and has active ingredients totally different from the combination of components used to make the catalyst discovered by Applicant. Specifically, Mason's catalyst "comprises sulfides of group VIII metals of the periodic table together with promoters selected from the oxides of metals of group IV of the periodic table." (Column 1, lines 2-7). The presently claimed catalyst does not require sulfides. While titanium dioxide may qualify as Mason's "oxides of metals of group IV," Applicant's catalytic compound is a reaction product of titanium dioxide with other components not mentioned or suggested by Mason (namely, ferric oxide, calcium oxide, transition metal salts or volcanic ash).

Furthermore, the catalyst in Mason is not an aqueous solution of reaction products like the presently claimed catalyst. Therefore, this reference in combination with the other references cited does not render Applicant's invention obvious.

In view of the foregoing, Applicant respectfully requests withdrawal of the obviousness rejections.

CONCLUSION

In view of the above comments and amendments, it is respectfully submitted that the subject application is now in condition for allowance. A Notice to that effect would be greatly appreciated.

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Respectfully submitted,

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